R&D FACILITY

facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER

GAS STREAM cleanup
PROJECT

FLUIDIZED-BED REACTOR AND HOT GAS CLEANUP FACILITY

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Capabilities

As part of the Federal Energy Technology Center's (FETC) Advanced Gasification and Hot Gas Cleanup Facility, a 907 kg (1 ton) coal-per-day (10-inch inside diameter) jetting fluidized-bed gasifier provides realistic fuel gas for testing and developing high-temperature, high-pressure components and processes in a reducing (gasification) and oxidizing (combustion) environment. Operated mainly as a gasifier, the 0.25-m (10-inch) diameter reactor produces up to 227 kg/hr (300 lb/hr) of coal gas at 1,200 K (1,700 °F) and 30 atmospheres (425 psig) for downstream testing. The raw coal gas is sampled for major and trace species and sent to a filter vessel capable of operating at 894 K (1,150 °F) and 20 atmospheres (300 psig) of pressure. After particulate removal, the gas can be transported to any of five sampling or reaction vessels for fluid-bed desulfurization; transport desulfurization; chloride, alkali, or other contaminant removal; or recovery processes. The fluid-bed desulfurizer is capable of being isolated, purged, or exposed to an oxidizing environment for sorbent regeneration or other oxidation reaction. Isokinetic sampling of hazardous air pollutants (HAPS) is provided upstream and downstream of particulate removal.

Over the past five years, 1,400 hours of operation have been completed in support of six separate CRADAs. These research agreements involve candle filters and materials testing, direct sulfur recovery from sorbent regeneration tail gases, and gasifier development.

Currently, two CRADAs are being performed that involve testing and development of candle filters. A study in support of the desulfurization process at the Sierra Pacific Piñon Pine Integrated Gasification Combined Cycle (IGCC) power plant is being conducted.

Opportunities

- Provide testing for advanced IGCC
  - Filtration experiments at 1,150 °F, 20 atm
  - Cyclic (reducing/oxidizing) reaction atmosphere for sorbent testing
  - Slipstreams for contaminants removal
- Provide testing for advanced PFBC
  - Filtration experiments at 1,600 °F, 30 atm
- Hardware and operational control strategy testing

FETC

Fluidized-Bed Reactor and Hot Gas Cleanup Facility

The Facility

FETC's **Fluid-Bed Gasifier** and the **Modular Gas Cleanup Rig** (MGCR) combined form the **FETC Gasification and Hot Gas Cleanup Facility**.

This unique facility is used to develop and test components, and to test technologies suitable for integrated gasification, combined-cycle — or IGCC — power-plant systems.

The **MGCR** is mainly used to test components, such as desulfurization sorbents, hot particulate-removal filters, and filter materials.

Testing is done at a pressure of 300 pounds per square inch and a temperature up to 1,150 °F.

The **Fluid-Bed Gasifier** is at product-development-unit (PDU) scale.

The 10-inch diameter reactor gasifies 80 pounds per hour of coal to produce 300 pounds per hour — or 5,000 standard cubic feet per hour — of combustible, low-Btu coal gas.

The gas is produced at high temperature — 1,700 °F — and high pressure — 425 pounds per square inch.

FETC hopes to use this Gasification and Hot Gas Cleanup Facility to facilitate commercialization of advanced power systems that can significantly reduce pollutants while increasing fuel efficiency — at the lowest possible costs.

The uniqueness of the combined Modular Gas Cleanup Rig and Fluid-Bed Gasifier is that testing is done with **real coal gas** that has a realistic composition and contains the trace metals and species inherent in the feed coal.

FETC's **Modular Gas Cleanup Rig** (MGCR), at left, and **Fluid-Bed Gasifier**, on the right, combined form the **FETC Gasification and Hot Gas Cleanup Facility**.

FETC's Fluid-Bed Gasifier

MGCR Particulate Removal and Desulfurization Equipment

The Control Room for the Fluid-Bed Gasifier